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How We Got Smart

Improving Interdisciplinary Communication When Summoning Neonatology to High-Risk Deliveries

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ABSTRACT

Communication around high-risk deliveries is critical to ensure patient safety. A hospital-wide system change in paging the neonatal resuscitation team (NRT) to deliveries was implemented but disliked. An interdisciplinary team seized the opportunity to explore opportunities for an enhanced system to improve communication. The team designed a new screen to our smart panel (responder 5 staff terminal, Rauland, Mount Prospect, Illinois) to page NRT with the location and primary indication for which they were needed at delivery. Surveys assessed user satisfaction among labor and delivery and NRT. Before and after implementation of the smart panel, we assessed number of NRT pages, frequency of NRT being paged prior to the delivery, the time between page and delivery, and use of the code button to summon help. Labor and delivery and NRT user satisfaction greatly improved with the smart panel. Frequency of NRT being paged before birth increased with fewer code pages being used to summon NRT to deliveries. A touch screen–based notification system can enhance timely notification to summon NRT to deliveries while concurrently enhancing satisfaction of providers in both the delivery room and on the NRT.

Key Words: communication, middleware, neonatology, newborn, obstetrics, paging, resuscitation, technology

Multiple research and quality improvement projects have targeted communication in specific situations such as handoffs and preoperative briefings. Other important situations involving communication in healthcare have not been well studied. In particular, communication between obstetric and neonatal teams during a high-risk delivery (a frequent occurrence nationally) is poorly studied. The Joint Commission identified ineffective communication as a contributing factor in 72% of reported obstetric sentinel events that resulted in either perinatal mortality or permanent disability.[1] Labor and delivery (LD) providers have cited coordinating activities with other units such as the neonatal intensive care unit as the most frequent communication barrier.[2] Such communication, however, is essential to allow the neonatal resuscitation team (NRT) to be optimally prepared to stabilize and resuscitate the newborn infant by ensuring availability of an adequate number and type of personnel, timely arrival to the delivery location, and adequate time for the team to set up equipment and plan for the resuscitation.

At our institution, a hospital-wide system change was imposed in July of 2015 to the way emergency response teams were paged. Prior to July 2015, hospital page operators took emergency calls from around the hospital and sent out group pages to the corresponding response team.[3] Starting July 21, 2015, however, a new

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hospital emergency response call center (ERCC) took over responsibility for paging all emergency response teams across the entire hospital system. The change caused us to evaluate the communication process of LD paging NRT to high-risk deliveries. An interdisciplinary team was formed to evaluate optimal NRT notification and designed a new paging system using a touch screen interface that was implemented on February 2, 2016.

This study had 2 specific aims: (1) to assess user satisfaction, reactions, and perceptions about the paging system changes and (2) to evaluate patient care processes around timeliness and performance of the new paging system.

METHODS

The problem

The prior method for summoning NRT consisted of the following steps:

1. Labor and delivery nurse called the paging operator at a number designated for NRT.
2. The nurse provided the operator with key scripted items of information—delivery location, gestational age, and the primary reason NRT was needed at the delivery.
3. The page operators typed the message containing the information they were given into software on a desktop computer terminal that sent the page to NRT.
4. Neonatal resuscitation team received the page as text messages on mobile phones and alpha numeric pagers.

This method was the result of a previous quality improvement project.[3] This paging system was used to transmit patient information and location of the delivery. It was generally well liked. However, a system change was mandated by the hospital for sending pages to all emergency response teams. The hospital sought to centralize emergency team paging into 1 center, the ERCC, staffed by Emergency Medical Services (EMS) trained operators with the primary goal of getting the correct team to the correct location as fast as possible. Hence, the primary goal of the page was to relay location and not patient information. The new summoning methods were introduced in 2 phases.

ERCC paging (phase 1)

The change to ERCC paging was a mandate from the hospital. Emergency response call center only asked for and sent pages with location, gestational age, and number of babies expected (to ensure the correct number of teams arrived). Gestational age was one piece of patient information requested by NRT and agreed to by ERCC to include in the pages. As part of this change, the item "primary reason NRT is needed" was removed from pages sent to the NRT. This method of summoning the NRT was used for 6 months.

A team was assembled from obstetrics, neonatology, nursing, ERCC, information technology, and quality and safety leaders. Frontline staff using the ERCC for summoning NRT and NRT members receiving pages were engaged in informal conversations to better understand concerns raised about the pages from ERCC. The team also reviewed ERCC-tracked data of all calls received, number of calls for each emergency response team, and length of calls.

Smart panel paging (phase 2)

After extensive discussions with ERCC, obstetric and neonatology teams, "smart panels" (responder 5 staff terminal, Rauland, Mount Prospect, Illinois) were introduced in February 2016 as a replacement for the telephone as a channel of initiating the request for NRT and transmitting information. The smart panel touch screen has preprogrammed buttons that can be selected. The smart panel communicates directly with middleware so that when a button is selected on the touch screen, the information is relayed to the middleware which then sends the page to NRT instantaneously.

The potential advantages of this system were (1) its ability for all the requisite information (including indication for the delivery) to be transmitted to the NRT faster and with less effort, as it eliminated the phone call to ERCC and the need for ERCC to type the information into the paging system; (2) easy availability—the smart panels were already installed in every delivery room and operating room; and (3) familiarity—the panels were already in use for codes and emergency team paging such as massive transfusion protocol and stat cesarean deliveries. The smart panel screens were programmed to display a customized list of 10 potential indications for summoning NRT (see Supplemental Digital Content Figure 1, available at: http://links.lww.com/JPNN/A9). Labor and delivery staff were to choose 1 indication per delivery.

User satisfaction surveys

Our team aimed to understand user satisfaction and perceptions of the paging system. Therefore, surveys (SurveyMonkey Inc) were disseminated to both LD nursing and NRT members by e-mail invitation 1 month before and 4 months after the introduction of the smart panel paging. The surveys asked questions about ease of use, ability to send or receive necessary information,

and overall satisfaction with the system. Where free text responses to questions were allowed, 2 of the authors (N.C.S. and G.G.) categorized the responses separately and then reconciled any differences in categorization of responses.

Patient care processes

To assess changes in patient care processes associated with the intervention that affected timeliness and performance of the system, we measured the following:

1. The percentage of time NRT arrived before birth of the infant. This was determined from our quality improvement database that tracks the time when NRT receives the page, the time NRT arrives at the delivery room, and the time of birth for all deliveries that NRT attends.
2. The amount of time NRT had before delivery to prepare. This was determined as the time interval from receiving the summoning page to birth as recorded in our database.
3. The frequency of use of the "code button" to summon NRT. The code button is an item on the smart panel touch screen which is meant to summon a code team to the location during acute emergencies. The messages generated by the code buttons are transmitted via the smart panel similar to other messages, and data about these messages are stored in a database within the communication system in a retrievable format.

For dichotomous and categorical measures, we calculated proportions of responses. The Wilcoxon rank sum test was used to compare survey responses before and after smart panel implementation. The χ^2 test was used to compare the proportion of deliveries for which NRT was paged before birth. For the continuous measure of time interval for NRT preparation, means and standard deviations were calculated and the phases of summoning compared using analysis of variance.

The survey and this research were approved by the Institutional Review Board of Baylor College of Medicine, protocol H-38189.

RESULTS

Emergency response call center

Shortly after ERCC implementation for paging NRT, we found that the change was strongly disliked by both LD and NRT providers. We determined that LD primarily disliked the inability to share the primary indication for NRT need and the additional questions related to location necessitated by ERCC coordinating multiple hospital locations. Neonatal resuscitation team disliked not having the primary indication for the request.

We also determined that a high percentage of calls to ERCC were for NRT summoning. From October 2015 to January 2016, the ERCC averaged 530 calls per month of which 277 (52% of all calls) were for NRT. However, after the smart panel paging system was implemented from February to May 2016, the average calls per month dropped to 308, of which only 33 (11% of all calls) were for NRT. The average number of deliveries did not differ between time periods (535 vs 478 deliveries per month), nor did the neonatal intensive care unit admission rate (21% vs 23% of all deliveries).

LD user satisfaction

Surveys were sent to all LD nurses (135 individuals) with a 54% to 55% response rate ($n = 73$ before, $n = 74$ after). Labor and delivery nurses satisfaction with the smart panel was enthusiastically positive (see Figure 1A). A mere 18% reported being satisfied or very satisfied before implementation of the smart panel, but this increased to 97% after implementation. When questioned on ease of use, 49% found the ERCC system easy to use while 99% found the smart panel easy to use. Of the free-text responses about ERCC paging ($n = 49$), the most common were that it took too long (67%) and that there were too many questions (35%). Comments about smart panel paging ($n = 18$) included that it was fast (61%), simple to use (28%), and "loved it" (28%). Labor and delivery nurses were also asked whether the ERCC questions or smart panel button options were appropriate. Only 43% felt that the ERCC questions were appropriate and 26% of respondents commented that they wanted to include more information about the delivery in the summoning page. In contrast, 95% felt that the smart panel choices were appropriate, though 9 of the 13 comments indicated that they wanted more options.

NRT user satisfaction

Surveys were sent to team members of NRT which included attending physicians, fellows, nurse practitioners, nurses, and respiratory therapists (93 individuals). Response rates were 74% before and 71% after smart panel paging implementation. Neonatal resuscitation team overall satisfaction was improved (see Figure 1B). Only 26% reported being satisfied or very satisfied prior to smart panel paging system implementation, but this increased to 64% following implementation. Neonatal resuscitation team members were asked to respond to 4 questions on a Likert scale (see Table 1). All questions demonstrated a shift in responses toward "often" or "always" after implementation of the smart panel paging

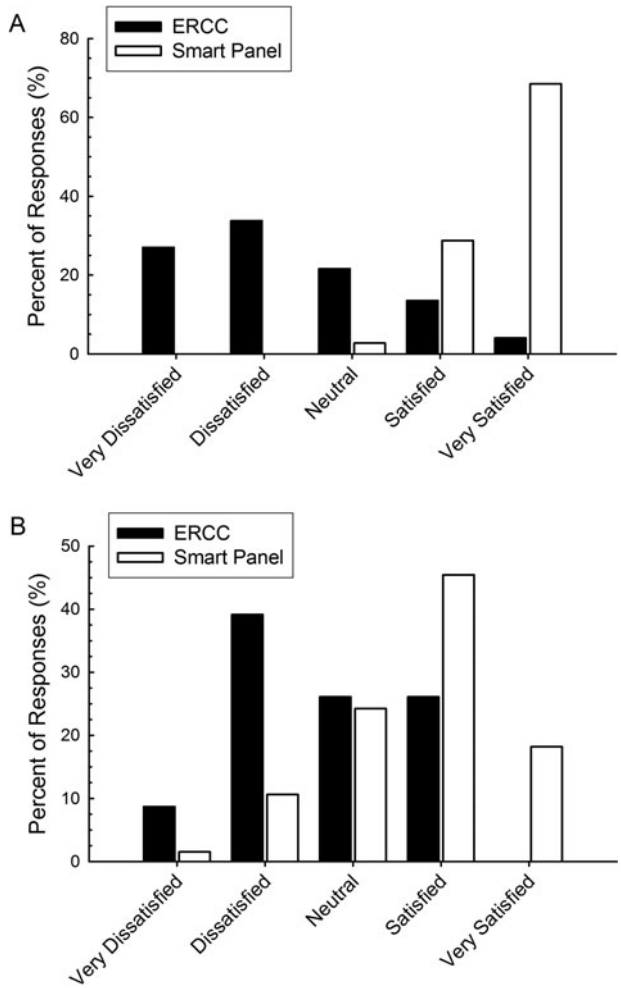

Figure 1. Overall satisfaction is improved with use of the smart panel paging. Survey responses were collected from time periods where only ERCC paging was in use and when smart panel paging was available. (A) Labor and delivery providers ($n = 74$ and 73, before and after). (B) Neonatal resuscitation team members ($n = 69$ and 66, before and after) both rated their satisfaction levels higher with the use of the smart panel paging ($P < .001$, before vs after, Wilcoxon rank sum test). ERCC indicates emergency response call center.

system. Even when all sources of information were considered (Question 4, see the Table), NRT members who felt that they often or always had the information they needed increased from 41% to 64% after implementation of the smart panel paging system.

Patient care processes

Previous quality improvement work had improved and sustained the rate of NRT arrival before births to 90% or more at our institution.[3] Implementation of the smart panel paging system increased the rate of arrival

Table 1. **Smart panel paging improved communication of information**[a]

Questions:	1. How often do you get the information you need to care for the patient from the page for delivery?		2. How often do you know the right diagnosis/reason for page before birth?		3. How often do you get paged with enough time to arrive, set up, and prepare for the delivery?		4. How often do you get all the information you need to care for the patient from all sources of information before the delivery of the baby?	
Era:	**ERCC**	**SP**	**ERCC**	**SP**	**ERCC**	**SP**	**ERCC**	**SP**
Never, %	10.1	0	5.8	1.5	0	0	2.9	0
Rarely, %	37.7	9.1	26.1	9.1	7.2	3.0	8.7	4.5
Sometimes, %	30.4	30.3	50.7	31.8	26.1	10.6	47.8	31.8
Often, %	20.3	56.1	17.4	57.6	60.9	78.8	36.2	59.1
Always, %	1.4	4.5	0	0	5.8	7.6	4.3	4.5
P	<.001		<.001		.015		.009	

Abbreviations: ERCC, emergency response call center; SP, smart panel.
[a]Number of responses from Neonatal Resuscitation Team members, $n = 69$ for ERCC and $n = 66$ for SP. All *P* values are from Wilcoxon rank sum test.

before delivery (see Figure 2). The goal at our institution is for NRT to arrive 10 minutes before the expected delivery or before the surgical time out in cases of cesarean delivery. The time interval between when NRT receives the summoning page for a delivery and the time of birth was compared. No significant difference in this time interval was seen with the implementation of smart panel paging (11.9 minutes preimplementation vs 13.2 minutes postimplementation, $P > .05$, analysis of variance).

Some members of NRT suspected that code alarms were being utilized as a way to quickly page NRT to deliveries rather than call ERCC. The numbers of code alarms from all delivery areas of the hospital were summed in biweekly intervals starting in mid-October 2015 (see Figure 3). The median biweekly number of code alarms for NRT was 9 before implementation of the smart panel paging. After smart panel paging, the biweekly number never exceeded the pre–smart panel median showing special cause variation. Labor and delivery were questioned about use of the code alarm in our surveys. Seventy-four percent of LD responders affirmed that they had used the code alarm to summon NRT in the preceding 3 months during the ERCC system and of those who had, 45% commented that it was to get NRT faster or to avoid additional questions of the ERCC operator that were required in a noncode. After implementing the smart panel paging system, only 34% of LD responders affirmed that they had used the code button in the previous 3 months and of those, all but 1 individual responded that they were in actual codes or very high-risk situations.

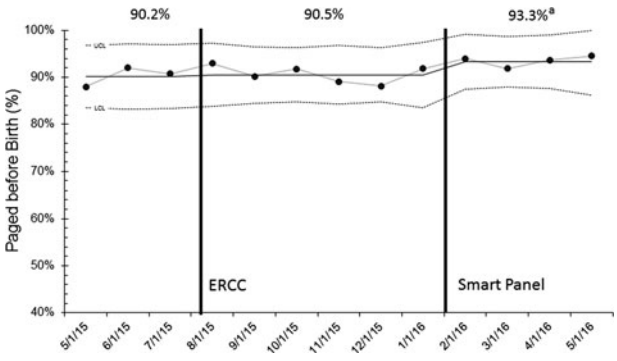

Figure 2. Timeliness of paging to the neonatal response team (NRT) is improved after smart panel paging. Given no national standard, our institutional goal is for NRT to be present before birth to 90% or more of the time they are summoned to a delivery room. A p-chart displays the monthly frequency which NRT was paged before the birth of the baby as a percentage of all the deliveries that NRT attended. Mean values for each time period are displayed. The frequency increased during smart panel paging compared with ERCC paging. ERCC indicates emergency response call center. [a]$P < .05$, χ^2.

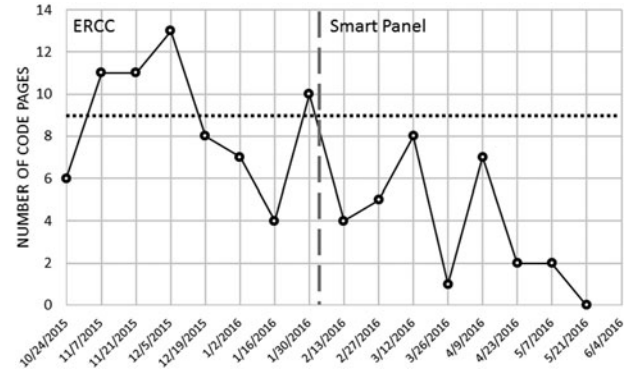

Figure 3. Code red pages decreased after smart panel paging. The number of code pages in biweekly blocks is displayed on a run chart. The dotted horizontal line is the median number during ERCC paging. The vertical dashed line shows the time smart panel paging was introduced. All 8 data points after the smart panel introduction do not cross the pre–smart panel median indicating special cause variation. ERCC indicates emergency response call center.

DISCUSSION

When called to the resuscitation of a high-risk neonate, neonatology requires accurate, comprehensive, and current information about the mother and the baby in order to optimally resuscitate and stabilize the baby. But when and how this information is optimally communicated is not known. At our institution, what had been perceived as a relatively small system change for summoning NRT to deliveries caused a lot of dissatisfaction and changes in behavior that could have impacted patient care. An interdisciplinary team seized upon the opportunity to develop and implement a better process. This process improvement resulted in a decreased number of calls to ERCC, an increase in both LD and NRT satisfaction with the revised paging process, and an increased rate of NRT's arrival before the birth of a high-risk neonate.

Given the increasingly complex and hazardous healthcare environment,[4] communication and teamwork both within and between teams has never been more important.[5,6] One response to this increasingly complex healthcare environment is addition of checklists and other forms of standardized communication. Others have shown that standardized communication processes decreased missing items of information being transmitted and improved user satisfaction.[7–9] In a survey of neonatal providers, we found that use of

a standardized communication process was associated with better satisfaction and more information sharing at high-risk deliveries.[10] This article demonstrates that not all standardized communication processes are the same. Just because the communication is standardized does not automatically lead to increased user satisfaction or better information sharing. In this project, leaders acknowledged the negative impact the conversion to using ERCC operators had on the system and welcomed an improved process. Feedback about the system change was sought from frontline care providers, and their recommendations were incorporated into the smart panel paging system.

We are not the first to use a technology-based system to improve communication between LD and NRT providers. Others changed the summoning communication from a verbal script to a computer-based script that sent a text message to NRT.[11] They tracked transmission of 5 critical delivery information items, and in all 5 cases items were transmitted more often with computer-based messaging.[11] They did not report on user satisfaction. We report on a similar solution to a similar problem. But in our case, the frequency of information transmitted was unchanged. Both ERCC and smart panel paging transmit the information they are designed to send accurately and consistently. But they transmit different information. For instance, every page from ERCC had the gestational age, but the smart panel page does not always contain this. Perhaps this is why NRT satisfaction with the change was less dramatic, though still substantially improved. It is intriguing, then, that NRT members reported more often or always having the information they needed after smart panel paging was introduced. Neonatal resuscitation team felt that the change in the paging system alone, even considering all sources and timing of information gathering, made it more likely to have all the information they needed. We believe this is because the smart panel page transmits the primary reason NRT is needed at the delivery whereas the ERCC page does not.

The change to smart panel paging system also changed behaviors around patient care processes. Pages through ERCC take approximately 1.5 minutes longer to reach NRT than pages from the smart panel. The use of the code button for nonemergency deliveries was a failure of the standard, nonemergency system for paging. Prior to smart panel paging of NRT, pressing this code button was the most rapid way for nursing to summon NRT and bypass calling ERCC. Now, the choices for summoning NRT are just one screen selection further than the code button. As a result, there is virtually no difference in the time it takes to page NRT using the code button or any of the new choices, and thus, code alarm use has diminished to appropriate indications. While not directly studied in this article, the combined effect of NRT having more pertinent information and arriving to deliveries in a timelier manner can only be expected to improve patient outcomes.

It is encouraging that such a system change improved communication, but we are cautioned that the percentage of NRT members who reported feeling they often or always received the needed information remains low. The smart panel options are limited by space on the panel. Labor and delivery nurses, however, have learned that selecting more than 1 smart panel option from the screen sends multiple pages in rapid succession and relays the multiple items of information to the same location. While this may reliably send more information, it cannot replace the face-to-face communication in the delivery room where NRT and LD teams must communicate essential information at every delivery.[12]

We report here on a solution to a communication problem that dramatically improved user satisfaction and improved timely arrival of NRT to high-risk deliveries. Two quotes from our surveys after the smart panel paging system was implemented stand out and describe the success of this change: "The smart panel is a necessity for the safety of our patients" and "It [smart panel] saves lives. It's as important as CPR."

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